(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 831 275 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
25.03.1998 Bulletin 1998/13

(51) Int. Cl.[6]: **F23R 3/26**

(21) Application number: **97115032.1**

(22) Date of filing: **29.08.1997**

(84) Designated Contracting States:
AT BE CH DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV RO SI

(30) Priority: **24.09.1996 JP 251443/96**

(71) Applicant:
Mitsubishi Heavy Industries, Ltd.
Tokyo (JP)

(72) Inventor:
Nakae, Tomoyoshi,
c/o Mitsubishi Heavy Ind., Ltd.
Higashi Tanaka, Komaki-shi, Aichi-ken (JP)

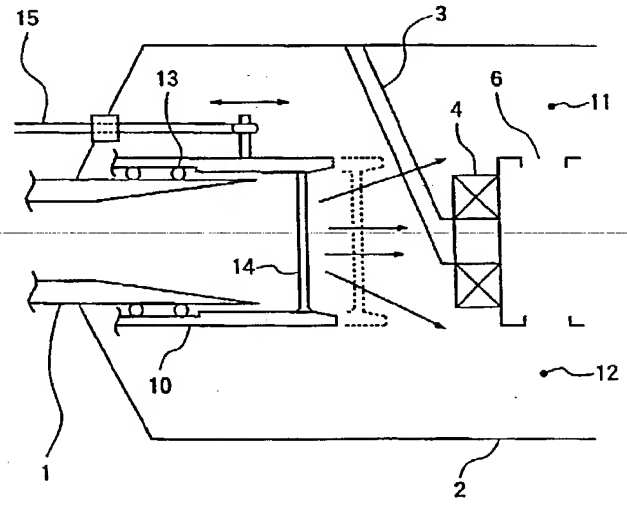
(74) Representative:
Henkel, Feiler, Hänzel
Möhlstrasse 37
81675 München (DE)

(54) Annular type gas turbine combustor

(57) Provided is an annular type gas turbine combustor of high reliability which can regulate air flow distribution without being influenced by high temperature flames and with a desired fuel-air ratio being obtained to reduce generation of NO_x etc.

A side duct (10) for regulating air flow distribution is disposed slidably in axial direction at a terminal end of a pre-dissuer (1) and as the slide duct (10) is moved, air flow supplied downstream to a swirler (4) is regulated so as to obtain a desired fuel-air ratio.

Fig. 2



EP 0 831 275 A2

Description

BACKGROUND OF THE INVENTION:

Field of the Invention:

The present invention relates to an annular type combustor applied to a gas turbine.

Description of the Prior Art:

One example of an annular type gas turbine combustor in the prior art is described with reference to Figs. 4 to 6. Fig. 4 is a schematic cross sectional view of a combustor, taken on a vertical plane including a turbine central axis, which shows an upper half portion only of the turbine central axis. That is, an annular type combustor forms a combustor which is concentric with the turbine central axis and annular (like a doughnut shape) surrounding the turbine central axis, together with a lower half portion (not shown) of the turbine central axis.

In Fig. 4, numeral 1 designates a pre-diffuser, numeral 2 designates a diffuser case, numeral 3 designates a fuel injector, numeral 4 designates a swirler, numeral 5 designates a liner, numeral 6 designates a dilution hole, numeral 7 designates a cooling hole and numeral 8 designates a rotating ring. In such combustor as so constructed, air passes through the pre-diffuser 1 and enters a combustion region surrounded by the liner 5 via the swirler 4, the dilution hole 6, the cooling hole 7, etc.

In said combustor, level of NO_x included in an emission gas is influenced by a ratio of fuel to air passing through the swirler 4 (hereinafter referred to as "fuel-air ratio"), and generally as the fuel-air ratio is lowered, the NO_x level becomes lower. Thus, in order to attain a low NO_x level under every operation condition of gas turbine, there is needed a mechanism for regulating said fuel-air ratio.

In the prior art combustor, therefore, a rotary type flow regulating mechanism, employing the rotating ring 8, if provided at the swirler 4, by which opening cross sectional area of the swirler is changed and the fuel-air ratio is regulated. As shown in Figs. 5 and 6, the rotating ring 8 has an approximately same structure as the swirler 4 and is constructed by swirling blades, each having a certain thickness. Air flow is regulated by the rotating ring 8 which is rotated so that a relative phase to the swirler 4 is changed.

That is, if air passage of the rotating ring 8 coincides with air passage of the swirler 4 at a contact plane, the opening cross sectional area becomes maximum and as the relative phase is caused to deviate from this state, as shown in Fig. 6, the opening cross sectional area can be reduced corresponding to the amount of such deviation. According to change of the opening cross sectional area, flow rate of air passing through the swirler 4 is increased or decreased with result that the fuel-air ratio can be regulated.

In said prior art combustor, the rotating ring which is a movable portion for regulating the fuel-air ratio is disposed at a position which is easily influenced by flames thus there is a problem that the rotating ring is heated to a high temperature so as to lose its durability and reliability. Also, in such arrangement, there is a problem that a complicated mechanism of the movable portion is needed as a countermeasure for thermal expansion etc.

SUMMARY OF THE INVENTION:

It is therefore an object of the present invention to provide an annular type gas turbine combustor of high reliability which is able to dissolve the problems in the prior art with a simple construction and to regulate the fuel-air ratio safely and securely.

In order to attain said object, the present invention provides an annular type gas turbine combustor comprising an air flow distribution regulating device which is disposed at a terminal end of a pre-diffuser and is slidable in an axial direction thereof, thereby when air supplied downstream from the pre-diffuser passes through the air flow distribution regulating device at the terminal end of the pre-diffuser, the air flow distribution regulating device is slid in the axial direction and distribution of the air flowing downstream is regulated in a desired direction so as to obtain an optimized combustion.

And said air flow distribution regulating device is disposed at the terminal end of the pre-diffuser, as mentioned above, which is apart from flames so as not to be influenced by the flames, thus there is no fear of lowering of durability due to high temperature flames.

The present invention also provides an annular type gas turbine combustor in which the air flow distribution regulating device is constructed by a plurality of divided objects which are divided in the axial direction and each of the divided objects is slidable in the axial direction independent of each other, thus the air flow distribution regulating device which regulates distribution of the air flowing downstream from the pre-diffuser is constructed by a plurality of divided objects which are slidable in the axial direction, thereby each of the divided objects can be slid to various sliding patterns so as to effect appropriate regulations to meet operation conditions.

The present invention also provides an annular type gas turbine combustor in which a roller is disposed between the pre-diffuser and the air flow distribution regulating device, thereby relative movement of the pre-diffuser and the air flow distribution regulating device is done smoothly by the effect of rolling of the roll and the distribution of air flow can be regulated securely and easily.

The present invention also provides an annular type gas turbine combustor in which each of the pre-diffuser and the air flow distribution regulating device has a circular cross sectional shape and is disposed concentrically with each other, thereby the supplied air flows in a

concentrically distributed form and the air flow distribution in the radial direction becomes uniform, so that a regular combustion can be attained.

The present invention also provides an annular type gas turbine combustor in which each of the pre-diffuser and the air flow distribution regulating device has a polygonal cross sectional shape and is disposed concentrically with each other, thereby even if the pre-diffuser is formed in a polygonal cross sectional shape, the air flow distribution regulating device can well conform to that shape and the distribution of air flow can be regulated securely.

The present invention also provides an annular type gas turbine combustor in which the air flow distribution regulating device has its end face formed in a wave shape, thereby there occurs a differential position in the axial direction between a tip position and a bottom position of the wave shape and making use of said differential position, flow-out position of the supplied air is caused to change in the axial direction, so that the distribution of air flow in the circumferential direction can be regulated finely.

The present invention also provides an annular type gas turbine combustor in which the air flow distribution regulating device is constructed rotatively around a gas turbine axis, thereby the air flow distribution regulating device is rotated in addition to movement in the axial direction and a fine and appropriate regulation of the air flow distribution can be effected further.

BRIEF DESCRIPTION OF THE DRAWINGS:

Fig. 1 is a schematic cross sectional view of a combustor of a first embodiment according to the present invention.

Fig. 2 is an explanatory view of regulation status of the combustor of Fig. 1.

Fig. 3 is a schematic cross sectional view of a combustor of a second embodiment according to the present invention.

Fig. 4 is a schematic cross sectional view of a prior art combustor.

Fig. 5 is a cross sectional view taken on line A-A of Fig. 4.

Fig. 6 is a cross sectional view taken on line B-B of Fig. 5.

DESCRIPTION OF THE PREFERRED EMBODIMENTS:

A first embodiment according to the present invention is described with reference to Figs. 1 and 2. It is to be noted that same portions as those in the above-mentioned prior art are denoted with same numerals in the figures and characteristic features of the present embodiment are described with repetitive description being omitted.

The air flow distribution regulating device of the present embodiment employs a slide duct 10, which slide duct 10 is disposed at an end portion of a pre-diffuser 1 concentrically with the pre-diffuser 1 so as to surrounded an outer circumferential surface of the pre-diffuser 1.

Although the figure does not show details, the slide duct 10 is constructed integratedly by two divided objects, one being an outer side portion shown in an upper part of Fig. 1 and the other being an inner side portion shown in a lower part of Fig. 1, with a strut 14 being interposed between said two divided objects.

Between the slide duct 10 and the pre-diffuser 1, a roller 13 is disposed, and an actuator 15 which connects to outside is connected to a portion of the slide duct 10, so that the slide duct 10, when pushed or pulled by the actuator 15, is movable in the axial direction of the pre-diffuser 1.

It is to be noted that the slide duct 10 as shown here is of two divided objects, upper and lower in the figure or outer and inner around the gas turbine axis, but it is not limited to the two divided objects but can be of a single unit or of objects divided into a plurality of more than 2 in a circumferential direction according to convenience of manufacture.

Further, the integrated slide duct may summarily be of a cross sectional shape conformable to, and slidable in the axial direction on, the shape of the pre-diffuser, whether circular or polygonal.

In the present embodiment as so constructed, as shown by broken lines in Fig. 2, if the slide duct 10 is moved to a downstream side (rightwardly in the figure), air led to the swirler 4 becomes dominant of straight flow components as shown by arrows parallel to the axial direction, thus amount of air that concentrates toward the swirler 4 increases with result that the fuel-air ratio becomes lower and NO_x can be reduced, especially at the time of a high load operation.

Contrary thereto, as shown by continuous lines in Fig. 2, if the slide duct 10 is moved to an upstream side (leftwardly in the figure), air component which flows outwardly as shown by arrows in a dispersing direction in the figure increases, thus the air led to the swirler 4 decreases with result that the fuel-air ratio becomes higher and unstableness of combustion at the time of low load operation can be avoided. That is, the air flow distribution to the outward direction and the axial direction changes and the fuel-air ratio at the swirler 4 where the air flow distribution decreases becomes higher.

Next, description is made on a second embodiment according to the present invention with reference to Fig. 3. It is to be noted that same portions as those in the above-mentioned prior art and first embodiment are denoted with same numerals in the figure and repetitive description is omitted.

In an annular type combustor using a slide duct 10 as an air flow distribution regulating device according to the second embodiment, while the slide duct 10 of the first embodiment is formed integratedly by the outer and

inner divided objects which are connected by the strut 10, said strut 10 is removed and each one actuator 15a, 15b is provided to the outer slide duct and the inner slide duct, respectively, so that each of said slide ducts is movable in the axial direction independently.

In the second embodiment, the outer slide duct and the inner slide duct are moved independent of each other and distribution of air flow led to an outer shroud passage 11 and an inner shroud passage 12 is regulated. Thereby, a ratio of flow rate of an outer dilution air and an inner dilution air can be changed and a temperature distribution of combustion gas at an outlet portion 9 of the combustor can be optimized.

It is to be noted that although a downstream side end face of the slide duct 10 is flat both in the first and second embodiments, an arbitrary shape of end face, such as uneven end face of wave-shape, for example, can be employed and also it is possible that the air flow distribution can be regulated in a circumferential direction.

Further, if said end face is formed other than in a flat one and the slide duct 10 is moved not only in the axial direction but also rotationally around the gas turbine axis, then a fine and appropriate regulation of air flow distribution can be effected further.

While embodiments of the present invention have been described above with reference to accompanying figures, the present invention is not limited thereto but may naturally be added with various changes in the concrete structure within the scope of the appended claims.

According to the present invention, by use of a very simple structure that the air flow distribution regulating device which is slidable in the axial direction is disposed at the terminal end of the pre-diffuser, distribution of air flow led to the downstream swirler can be regulated, and by this flow regulation, fuel-air ratio can also be regulated with result that the fuel-air ratio is lowered at the time of high load operation and NO_x can be reduced. Also, at the time of low load operation, the fuel-air ratio is enhanced so that a stable combustion can be attained.

And yet, the air flow distribution regulating device is disposed in a close vicinity of the pre-diffuser, thus it is not influenced by flames, its movable portions can be made simpler and an apparatus of high durability and reliability can be provided.

Also, according to the present invention of Claim 2, the air flow distribution regulating device is constructed by divided objects divided into a plurality and each of the divided objects is made movable independent of each other, thereby a fine regulation of air low corresponding to combustion state becomes possible and a combustion gas temperature distribution at the outlet portion of the combustor can be optimized.

Further, according to the respective invention of Claims 3 to 7, partial variations, such as a construction that the roller is disposed between the pre-diffuser and the air flow distribution regulating device, a construction that the pre-diffuser and the air flow distribution regulating device, each, has a circular or polygonal cross sectional shape and is disposed concentrically with each other, a construction that the air flow distribution regulating device has its end face formed in a wave-shape and a construction that the air flow distribution regulating device is constructed rotatively around the gas turbine axis, are appropriately selected and added, thereby distribution of supplied air flow can be finely regulated in the axial direction and circumferential direction.

Claims

1. An annular type gas turbine combustor characterized in comprising an air flow distribution regulating device (10) which is disposed at a terminal end of a pre-diffuser (1) and is slidable in an axial direction thereof.

2. An annular type gas turbine combustor as claimed in Claim 1, characterized in that said air flow distribution regulating device (10) is constructed by a plurality of divided objects which are divided in the axial direction and each of the divided objects is slidable in the axial direction independent of each other.

3. An annular type gas turbine combustor as claimed in any one of Claims 1 and 2, characterized in that a roller (13) is disposed between said pre-diffuser (1) and said air flow distribution regulating device (10).

4. An annular type gas turbine combustor as claimed in any one of Claims 1 to 3, characterized in that each of said pre-diffuser (1) and said air flow distribution regulating device (10) has a circular cross sectional shape and is disposed concentrically with each other.

5. An annular type gas turbine combustor as claimed in any one of Claims 1 to 3, characterized in that each of said pre-diffuser (1) and said air flow distribution regulating device (10) has a polygonal cross sectional shape and is disposed concentrically with each other.

6. An annular type gas turbine combustor as claimed in any one of Claims 1 and 2, characterized in that said air flow distribution regulating device (10) has its end face formed in a wave shape.

7. An annular type gas turbine combustor as claimed in Claim 6, characterized in that said air flow distribution regulating device (10) is constructed rotatively around a gas turbine axis.

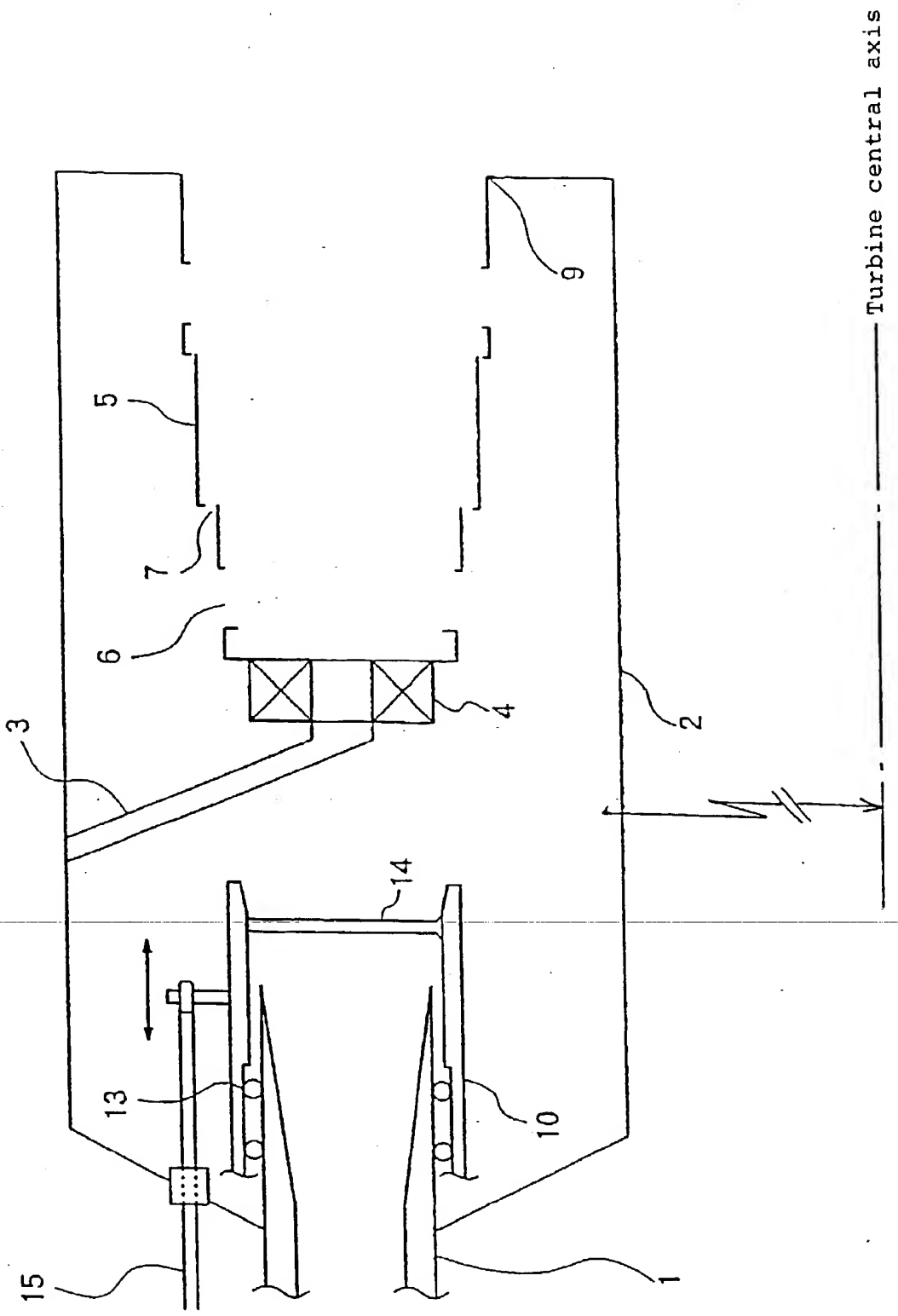
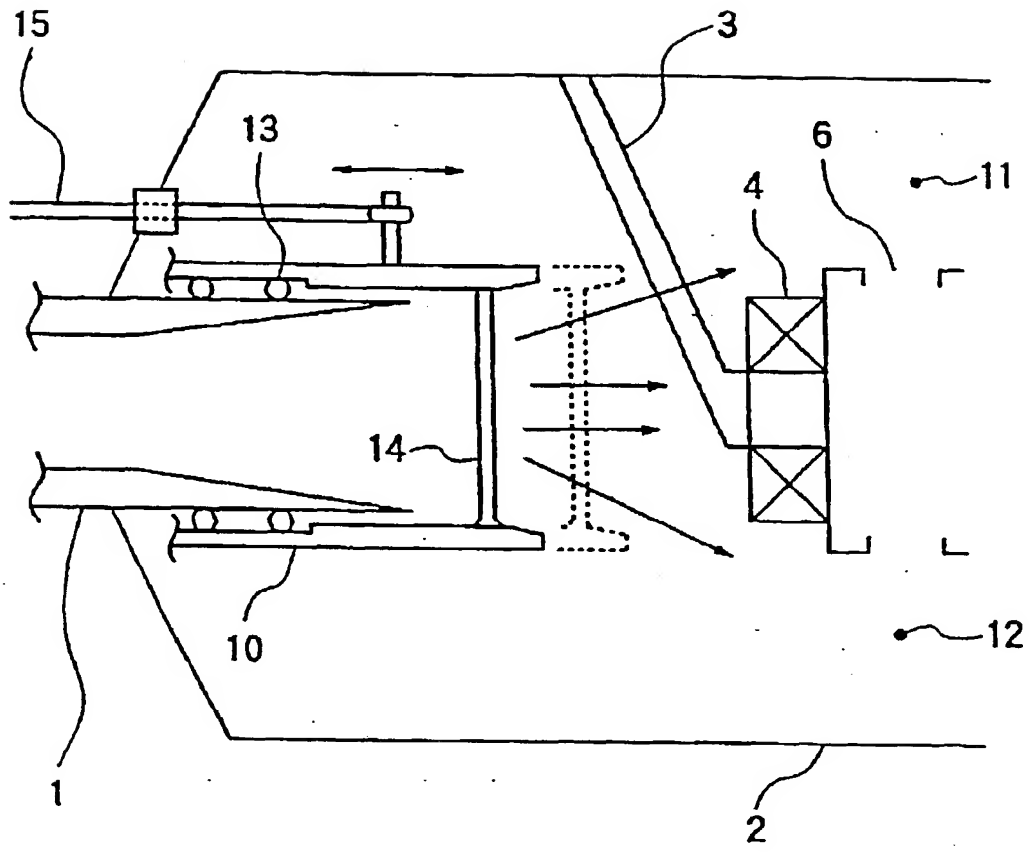


Fig. 1

Fig. 2



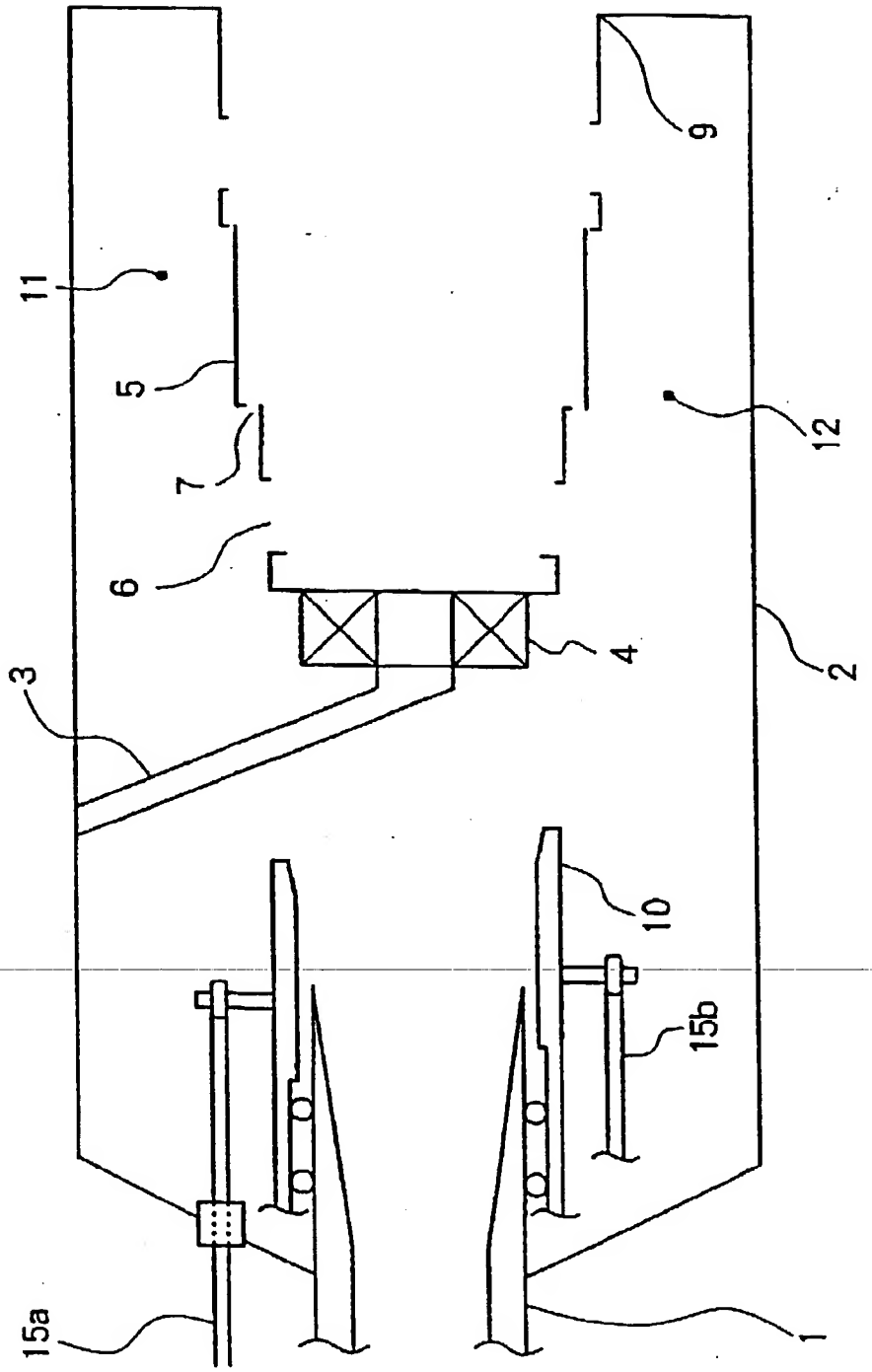


Fig. 3

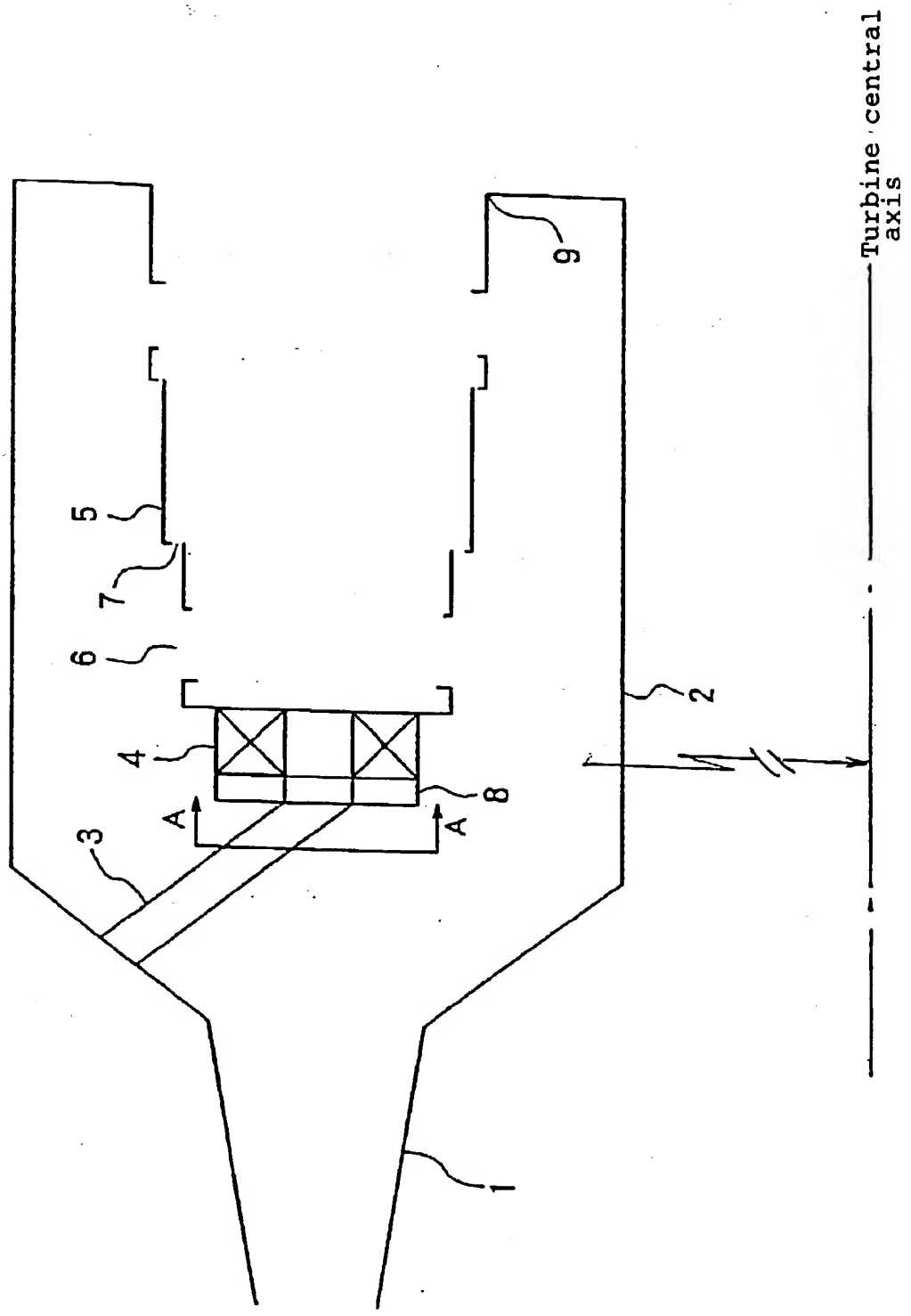


Fig. 4

Fig. 5

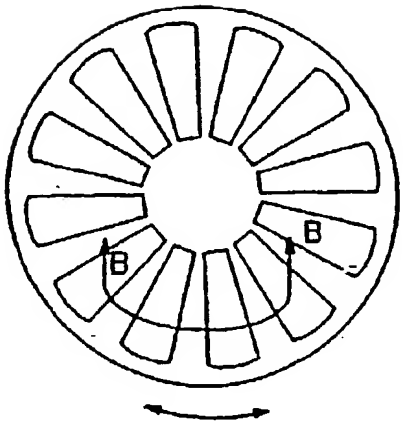
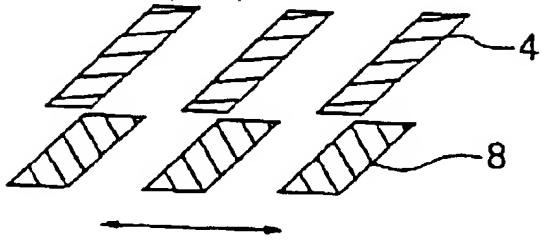


Fig. 6



(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 831 275 A3

(12) EUROPEAN PATENT APPLICATION

(88) Date of publication A3:
19.07.2000 Bulletin 2000/29

(43) Date of publication A2:
25.03.1998 Bulletin 1998/13

(21) Application number: **97115032.1**

(22) Date of filing: **29.08.1997**

(51) Int. Cl.[7]: **F23R 3/26**

(84) Designated Contracting States:
AT BE CH DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV RO SI

(30) Priority: **24.09.1996 JP 25144396**

(71) Applicant:
Mitsubishi Heavy Industries, Ltd.
Tokyo 100-0005 (JP)

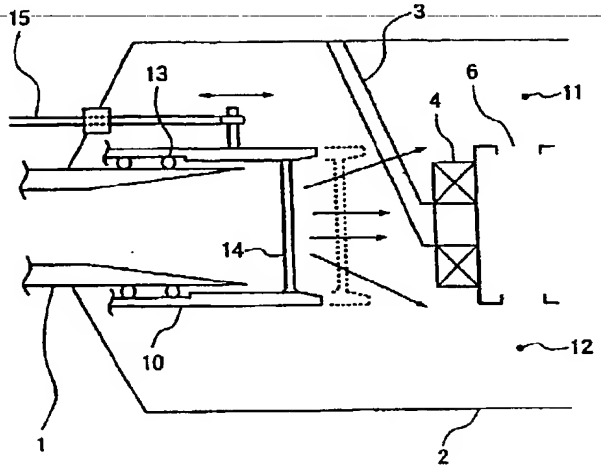
(72) Inventor:
Nakae, Tomoyoshi,
c/o Mitsubishi Heavy Ind., Ltd.
Higashi Tanaka, Komaki-shi, Aichi-ken (JP)

(74) Representative:
Henkel, Feiler, Hänzel
Möhlstrasse 37
81675 München (DE)

(54) Annular type gas turbine combustor

(57) A side duct (10) for regulating air flow distribution is disposed slidably in axial direction at a terminal end of a pre-diffuser (1) and as the slide duct (10) is moved, air flow supplied downstream to a swirler (4) is regulated so as to obtain a desired fuel-air ratio. In this way the air flow distribution can be regulated to obtain a desired fuel-air ratio to limit the generation of NO_x. The regulating device is not influenced by the high temperature of the flames in the combustion chamber.

Fig. 2



EP 0 831 275 A3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 11 5032

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	EP 0 529 900 A (HITACHI LTD) 3 March 1993 (1993-03-03) * abstract; figures 2-4 *	1	F23R3/26
X	EP 0 312 620 A (HITACHI LTD) 26 April 1989 (1989-04-26) * figures 1,2 *	1-3	
X	US 5 343 693 A (KOMATSU YASUTAKA ET AL) 6 September 1994 (1994-09-06) * figure 1 *	1,4	
X	US 4 532 762 A (MONGIA HUKAM C ET AL) 6 August 1985 (1985-08-06) * abstract; figures 3,8 *	1,4	
X	US 3 905 192 A (PIERCE ROBERT M ET AL) 16 September 1975 (1975-09-16) * figures 3,4 *	1	
A	US 4 044 549 A (ZWICK EUGENE B) 30 August 1977 (1977-08-30) * figures 5-8,12 *	1	TECHNICAL FIELDS SEARCHED (Int.Cl.6) F23R

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	19 May 2000	Argentini, A

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 97 11 5032

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

19-05-2000

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0529900 A	03-03-1993	JP 2954401 B	27-09-1999
		JP 5052125 A	02-03-1993
		DE 69215295 D	02-01-1997
		DE 69215295 T	28-05-1997
		US 5327718 A	12-07-1994
EP 0312620 A	26-04-1989	DE 3770823 D	18-07-1991
		US 4829764 A	16-05-1989
US 5343693 A	06-09-1994	JP 5079629 A	30-03-1993
US 4532762 A	06-08-1985	DE 3364029 D	17-07-1986
		EP 0100135 A	08-02-1984
		US 4594848 A	17-06-1986
US 3905192 A	16-09-1975	CA 1028511 A	28-03-1978
		DE 2538512 A	11-03-1976
		FR 2283321 A	26-03-1976
		GB 1489496 A	19-10-1977
		IN 142712 A	20-08-1977
		IT 1042151 B	30-01-1980
		JP 51085033 A	26-07-1976
		SE 7509617 A	01-03-1976
US 4044549 A	30-08-1977	US 4138842 A	13-02-1979
		US 4171612 A	23-10-1979

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82